Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Environmental Sciences 16 (2012) 616 – 623

Procedia Environmental Sciences

The 7th International Conference on Waste Management and Technology

Food-pack waste systemic management.

Alternative ways to reuse materials and to develop new business, products and local markets.

Clara Ceppa[a], Gian Paolo Marino[a]

[a]*Politecnico di Torino, DAD - Department of Architecture and Design, Viale Pier Andrea Mattioli 39, Torino 10125, Italy*

Abstract

On the basis of latest data published by Eurostat (the statistical office of the EU) in 2008 Europe produced 80 million tons of packaging waste. Specifically, Italy produces about 12 million tons per year of waste from packaging, 2/3 of which derive from the food processing sector. This paper does not address the issue of proper disposal of waste by consumers; on the contrary, it studies the problem of the waste that occurs before the products distribution phase, since it has not been sufficiently addressed enough. The focus, therefore, pertains to pre-production phase in the food packaging industry. Currently, rejects generated by that sector represent a large amount of waste upstream of the primary production cycle. Through its more exhaustive and far-sighted analysis and the application of the methodology of Systemic Design, whose fundamental principle is that waste (output) of a process become the resource (input) to another one, pre-production waste can in fact be reused by other industries. This generates a virtuous network of exchanges between geographically close companies that achieve economic and environmental benefits from the sale of secondary raw material. The result ends in a less use of raw materials, an increased use of resources already on site and, consequently, in a greater traceability of the same resources used in industrial processes so as to ensure, by implication, a high quality finished product. The ultimate goal of the proposed research is to design a self-sustaining network of companies that can interface and confront each other by creating a virtuous cycle in order to exploit the resources available (output) and limit production of surplus packaging.

Keywords: sustainability; food-pack waste systemic management; enhancement of material (output) reuse.

doi:10.1016/j.proenv.2012.10.084

1. Introduction

How much is the amount of waste arising from packaging? On the basis of latest data published by Eurostat (the statistical office of the EU) in 2008 Europe produced 80 million tons of packaging waste.

Specifically, Italy produces about 12 million tons per year of waste from packaging, 2/3 of which derive from the food processing sector. From a probe, made by Coldiretti (Italian association of farmers), is emerged that more than half the size of dustbin in Italian houses is occupied by cans, bottles, packages with which products of the grocery shopping are packaged.

This is due to the latest trend, which promotes a reduction of portions (e.g. mono-serving) or disposable packaging.

The packaging thrown in the garbage have increased since 2000 by more than 1 million tons (+9%) but with an increase of 60% of the packaging recycling activities [1].

Nowadays, for the health of the environment and human being, becomes fundamental to rethink the food-pack waste management following the Systemic Design principles as shown below.

2. Systemic Design methodology

The time has come to realize that our current productive activities produce a large amount of waste and squander most of the resources they take from Nature. To give an example, when we extract cellulose from wood to make paper, we cut down an entire forest but use only 20-25% of the trees while the remaining 70-80% are thrown away as waste. Palm oil makes up only 4% of the overall biomass of the palm tree; coffee beans make up only 4% of coffee bushes. Breweries extract only 8% of the nutritional elements contained in barley or rice for fermentation [2].

Humans have recognized the problem too late and have tried to solve it downstream of the process of using the product. These actions that later proved to be inefficient. This occurred because we have always thought of production processes as a sequence of actions, independent from one another, implemented to produce a commodity. Along with said commodity a huge amount of waste is produced. Said waste is considered an obvious result, along with the finished product, of the manufacturing process. And as such it is accepted.

In the current-day manufacturing model, the focus is exclusively on the product. By thinking of the product as of the main focus of the project, we immediately outline the values correlated to it, such as its economic value, its value as a status symbol, possession, communication. Nonetheless today harming the environment, lacking resources and the myth of unlimited development favor that more and more consumers begin to purchase product in a conscious way and buy more environmental friendly products [3].

In a world that is ever more complex, like the world we inhabit today and will inhabit in the future, we must extend our gaze to the entire production process and see it in its entirety, i.e. not by single phases. We must deal with everything produced, products and waste, to start implementing targeted actions to achieve a substantial harmonization of the relationship between the environment and local communities. This is one of the principles underlying systemic design: to think by connections allows us to see each anthropic process in a new light, and by viewing the entire system we can pursue the goal of zero emissions.

Therefore we need to seek out new ways of producing that guarantee remarkable results in social, ethical and environmental terms and lead to an improvement in the quality of life. We need to be conscious that we are part of a complex system that is not linear: it is an ecosystem. We are all members of the Oikos, the Greek word meaning “earthly family” from which we derive the word “ecology”; as such we should behave as the other members of this family behave, the plants, animals, microorganisms

forming the vast web of relations we refer as "the Web of life". This living global web has hatched, evolved and diversified over the last 3 billion years without ever breaking down [2]. The preeminent trait of the earthly family is its innate capacity to sustain life. As members of the global community of living beings we must act in ways that do not interfere with this intrinsic capacity. This is the essential meaning of ecological sustainability. In a sustainable community the foremost concern, i.e. what needs to be sustained, is not economic growth and development but the entire web of life on which long-term survival depends. It is designed in a way that its lifestyles, economic and financial organization, physical structures and technologies do not interfere with the intrinsic capacity of Nature to sustain life. Sustainability is not an individual property but the property of an entire network of relationships. In other words it involves the whole community. A sustainable human community interacts with other living systems, human and nonhuman, in ways that allow these the systems to live and develop according to nature. In the human sphere sustainability is fully compatible with having respect for cultural integrity, cultural diversity and the fundamental rights of the various communities to self-determination and self-organization.

In this kind of scenario producers are stimulated to design and manufacture ecologically sustainable products and services that will be in harmony with the system of the natural world: the productive process must turn to Nature [4] in order to understand the complexity of a system made up of relations between different beings and the continuous evolving flow of matter.

In terms of sustainability, the "projects" and "technologies" of Nature are far superior to human science and technology. We must apply our ecological knowledge and know-how to the fundamental redesign of our technologies and social institutions in order to fill the gap that today separates human design from the ecologically sustainable systems of nature.

Moreover in Nature there is no such thing as waste and even surpluses are metabolized by the system itself [5]. If these conditions, which are fundamental for a living system, are adopted in production, they will favour the development of a zero-emissions production precisely because the waste (output) of one process is used as a resource (input) for another one. The outputs are enriched with new value and become a resource available to be in the manufacture of new products closely associated with the local skills.

Therefore it becomes possible to create new manufacturing scenarios where the output of one company, a useless material to be eliminated incurring expenses only, can be reused to ensure the survival of another company related to the business category or physical location of the first company. In this sense all in industrial production must reduce the use of no-renewable materials and evolve toward less energy-consuming processes, making uncontaminated outputs that can be reused for their qualities.

The above mentioned concept is the first of the five principles of Systemic Design [6] which are:

- the output of a system becomes the input for another one;
- self-producing systems sustain themselves by reproducing automatically, thus allowing them to define their own paths of actions, and jointly co-evolve;
- the local context is fundamental cause it values local resources (e.g. human, culture, materials) and helps resolve local problem by creating new opportunities;
- the systemic approach is based on relationships: each one contributes to the system and the relationships can be within the system or outside of it;
- man connected to own environmental, social, cultural and ethical context.

By the proposed methodology and the corresponding re-evaluation of the rejected material, it becomes possible to skip treatment costs and create a network for selling one's own output. This generates greater profits and benefits to the territory due to the realization of new enterprises, the development and improvement of the already established enterprises and the creation of new jobs.

It is a process that can be applied to any production sector. It is deliberately applied locally to enhance local potentials and specificities and strengthen the bond with tradition. Another reason it is applied locally is to avoid the high costs of transportation along with the air pollution it creates.

The methodology of Systemic Design, therefore, substantially contributes to totally rethink the approach to the design and production of finished products, both upstream and downstream.

Many have been academic studies and practical applications that have proven successful in redefining the production scenarios. But experience has also shown that these scenarios involves rethinking the parallel review of some priorities for decades considered as cornerstones of economic, technological and social development. If until now the major industries were the real "engine" of such a growth model which then also small companies were forced to adapt to not succumb, from now on it seems that these latter will just have the opportunity to demonstrate the productive world how the "systemic thinking" could concretely be effective and efficient. In a period of economic crisis like the one we are dramatically experiencing, a "top-down" approach seems to be the answer to globalization that ultimately made it. Finding alternative ways to use what is called "waste" (be it both industrial and household), would include the development of new business, new products and the strengthening of local markets with consequent positive impact on the environment and living beings.

The following case study, in which the management of waste from food-pack has been revised on the basis of Systemic Design principles, shows us how a small local company alone may already contribute to the sustainability. If many other small local businesses would similarly act, then the positive effects would be very substantial indeed.

In the end arises the question: what if, finally, the big industrial giants (from food to electronics, from automotive to medical sector, etc.) would try to apply the systemic thinking in a more incisive way? The answer would be pretty obvious.

3. Case study: an Italian artisanal chocolate workshop

The case study will not address its issue towards the proper disposal of waste made by consumers themselves, but it will consider the problem of waste management that occurs earlier in the distribution of finished products, that is to a level BtoB (Business to Business) of edible goods and their associated packaging.

Raw materials (which are necessary to obtain finished products) and packaging (useful for their retail reach industrial plants and workshops) arrive, in turn, wrapped in additional packaging.

Currently, these latter represent a large amount of waste, upstream of the primary production cycle. Through a systemic analysis, however, waste may instead represent an economic resource to be used in both the industry and energy sectors, thereby triggering new business with low environmental impact.

The future goal will be to design a self-sustaining network of producers, in order to offer an effective alternative to those packaging thrown away during the pre-production phase.

The specific case study refers to an Italian artisanal chocolate workshop located in North-West of Italy (company size: 5 employees; turnover: $\leq$ € 1 million) and shows how it can be possible to successfully use (under an economic, environment and, last but not least, social point of view) all those packages that would not be usable otherwise.

For this reason, full paths of the primary packaging (that one which protects each ready-for-consumption product – e.g. jute sacks), secondary packaging (that groups a certain number of individual ready-for-consumption products – e.g. cardboard boxes) and tertiary packaging (intended to protect and facilitate the movement of in-transit goods – e.g. pallets) were analysed, starting from the production until the possible disposal and recycling phases [7]. Through this analysis (called holistic survey), it was possible to identify the types and amounts of annual packaging waste (output) produced by the artisanal

workshop so to define, throughout the subsequent systemic design phase, their new uses as resources (inputs) to other production activities.

3.1. The holistic survey of current situation

Currently, food raw materials (e.g. cocoa beans, spices, etc.) come to the workshop packed in sacks made of different materials and sizes; once emptied, they are collected separately.

The workshop produces the following amount of waste per year:

- 66 jute sacks = 43 kg;
- 160 Nylon sacks (polyamide) = 10 kg;
- 350 LDPE sacks (low-density polyethylene) = 10.5 kg;
- 350 PAP sacks (cardboard) = 93 kg.

Table 1. Current annual sacks waste (output) produced by the artisanal workshop

	Different materials of sacks			
	Jute	Nylon	LDPE	PAP
Type	Textile fabric	Plastic	Plastic	Paper
Universal Code	61 – TEX	PA	04 - LDPE	21 – PAP
Kg per year	43	10	10.5	93

Those packaging intended to protect finished products (e.g. tapes, boxes, etc.), also come, in turn, wrapped in other packages.

Thus, every year the workshop produces the following amount of waste:

- PAP secondary packaging cartons (cardboard) = 1,400 kg;
- PAP reels (cardboard) = 8 kg;
- PP reels (polypropylene) = 4 kg;
- HDPE supports for sticky labels (high-density polyethylene) = 18 kg;
- CA supports for sticky labels (paper based polylaminate) = 9 kg.

Table 2. Current annual packaging waste (output) produced by the artisanal workshop

	Different materials of packaging				
	Secondary packaging cartons	Cardboard reels	Plastic reels	Plastic support for sticky labels	Polylaminate support for sticky labels
Type	Cardboard	Cardboard	Plastic	Plastic	Polylaminate
Universal Code	PAP	PAP	PP	HDPE	CA
Kg per year	1,400	8	4	18	9

However, following the principles of Systemic Design, problems described above can be faced and improved. For this purpose, new flows of matter were outlined in order to allocate the waste produced by

the workshop at local companies, which can then reuse them as raw materials in their production processes.

Thus, the 1,500 kg of paper and cardboard derived from boxes, supports of sticky labels, sacks and cores of reels can be valued in a company, located 59 km away, so to produce sound deadening boards and thermal insulation flakes cellulose for walls, roofs and attics to be used to improve the indoor comfort of home. With both recovered paper and cardboard, then, it could also be possible to produce insulators for electrical sector as well as cones and diaphragms for loudspeakers: that would either imply the transportation of thrown away paper material to companies currently located at a distance less than 250 km away from the workshop, or boosting new companies that are sited within shorter distances in order to contain costs and emissions.

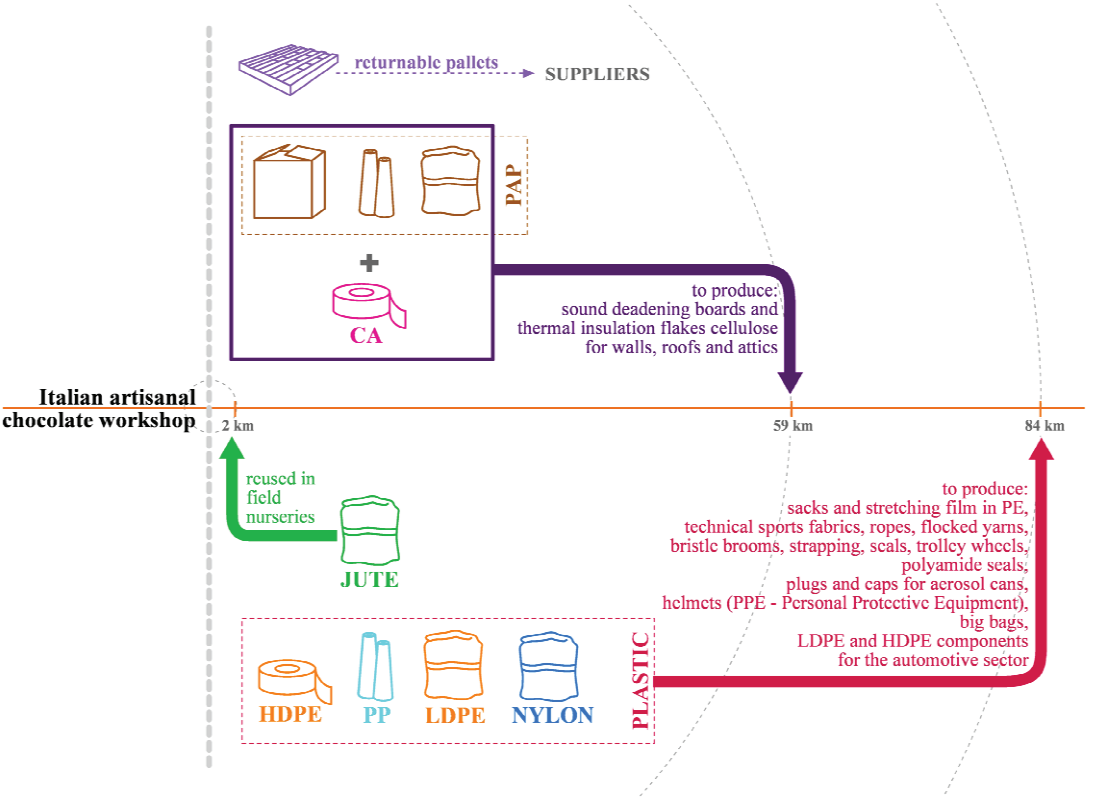

Fig. 1. Systemic proposal about output reuses

Through a transformation process (yarn close-meshed trimming), cocoa jute sacks can be used in naturalistic engineering works to carry the revegetation of slopes subject to landslides. On the contrary, in the case sacks do not undergo additional processing, jute can be reused as such in field nurseries for many purposes. In this regard, the systemic project proposes a working collaboration with one of the many field nurseries sited in the area, which is only 2 km away from the workshop itself.

Having waste made up of small quantities of various plastics, it might be more convenient to give them to a single transforming company so to limit transports and reduce logistics parameters (kilometres and

CO_2 emissions). For this reason it has been chosen a company, situated 84 km away, which is able to manage, by means of mechanical recycling, all the workshop plastic waste such as low and high density polyethylene, the polyamides and polypropylene.

The plastics, first shredded and then divided by type in big bags, supply a considerable number of other companies specialized in plastic manufacturing which, in turn, can produce more products such as:

- sacks and stretching film in PE for the handling of pallets;
- technical sports fabrics, ropes, flocked yarns, bristle brooms, strapping, seals, trolley wheels and polyamide seals;
- plugs and caps for aerosol cans, bottles, containers, ropes, helmets (PPE - Personal Protective Equipment), big bags and LDPE or HDPE components for the automotive sector.

As shown in the systemic diagram above, different fields of application, other than food-pack sector were chosen. This choice is due to the fact that a food pack, under current legislation, must always be produced with virgin materials in order to prevent contagions or dangerous migration of food particles.

Thus, the artisanal workshop will produce chocolate bars, truffles, “cremini”, custards, dragées and “giandujotti”, as well as other products with high technological content simply by using materials previously thrown away and considered as worthless, with no additional costs, so increase its revenues through the sale of these new materials. This implies, in parallel, triggering and/or further on developing productive activities, new products and local markets with strong territorial impact on the economy.

4. Conclusions

The work of investigation and theoretical application highlighted by the case study, allowed us to fully understand everything about the life-cycle of the “product packaging” wich is handled within a small company. As noticed, such an approach offers a possible solution to the problem of wasted materials, a new model of systemic management of waste derived from food-pack, thanks to the active collaboration of some productive and commercial activities geographically close to the artisanal firm. The final project should not be considered as a final destination point, but a point from which to start promoting future developments in the field of systemic requalification instead.

The potentiality of the project lies in:

- creating a synergistic and territorial cluster of artisanal and small/medium enterprises (SMEs);
- promoting the system concept (and subsequently that of Systemic Design) in the management of outputs and inputs (packaging, materials, products, etc.) so to limit the amount of waste and the wastage of energy resources;
- giving rise to possible new jobs for the management, administration and logistics of inputs and outputs which are thrown away or produced by companies that join the service.

This work is therefore a first attempt in wanting to sustainably manage the problem of packaging waste by following basic notions of the systemic approach. The privilege of being able to dissect every aspect of a specific case study, allowed us to work on complex realistic data without having to resort to incorrect speculation or aseptic statistics.

It is hoped that in time the proposals suggested by the case study can serve as a basis for developing further research in this direction or become a concrete reality, both economically and environmentally advantageous, which can then be shared by a growing number of businesses scattered over the territory.

References

[1] Badalucco L. *Il buon packaging. Imballaggi responsabili e sostenibili in carta, cartoncino e cartone*. Milano: Edizioni Dativo; 2011.

[2] Capra F. *The Hidden Connections*, New York: Doubleday; 2004, p. 315-316, 340-342

[3] Paulesich R. Sustainable consumption: a crucial aspect of research in economics. Peer reviewed article in the *International Journal Progress in Industrial Ecology*. Vol. 5, no. 1/2, 2008; 149-159.

[4] Gallopoulos N.E. Industrial ecology: an overviewed. *International Journal Progress in Industrial Ecology*. Vol. 3, no. 1/2, 2006; 10-27.

[5] Bistagnino L. Ispirati alla natura. *Journal Slowfood* n. 34, June 2008; 104-105.

[6] Bistagnino L. *Design Sistemico/Systemic Design*, 2a edition, Milano: Edizioni Ambiente; 2011

[7] Ceppa C, Fassio F, Marino GP. *Food-Pack Guidelines*, Torino: Time&Mind Press; 2008.